
Li-Ion Battery Cell Manufacturing

Sehan Benjamin Kwon
LG Chem Michigan Inc.
May 11, 2010

Project ID # **ARRAVT001**

Program Overview

Timeline

- Start date: 09/01/2009
- End date: 05/31/2013
- Percent Complete: 20%

Budget

- Total Project Funding:
 - DOE Share: \$151,387,000
 - LGCMI Share: \$151,403,339
- Funding Received in FY10:
 - \$14.9M
- Funding for FY11 Project Funding: → \$9.2M

Barrier

- Environmental Permits
- Construction/Building Permits
- Investment Cost Increase

Partners

- DOE/NETL
- LG Chem Ltd.
- Architect & Engineering Firm
- Design Builder
- State of Michigan
- City of Holland, MI

Company: LG Corp. and LG Chem.

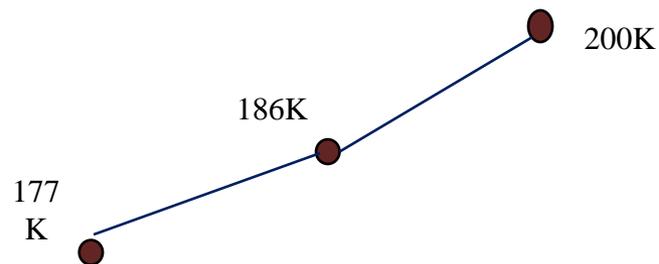
LG Corp.'s Business Area

Chemicals	Electronics	Comm.& Services
<ul style="list-style-type: none"> •LG Chem •LG Hausys •LG Household & Health Care •LG Life Sciences •LG MMA 	<ul style="list-style-type: none"> •LG Electronics •LG Display •LG Innotek •Hiplaza •Siltron •Lusem 	<ul style="list-style-type: none"> •LG U+ •LG CNS •LG Solar Energy •HS Ad •LG International •LG Sports

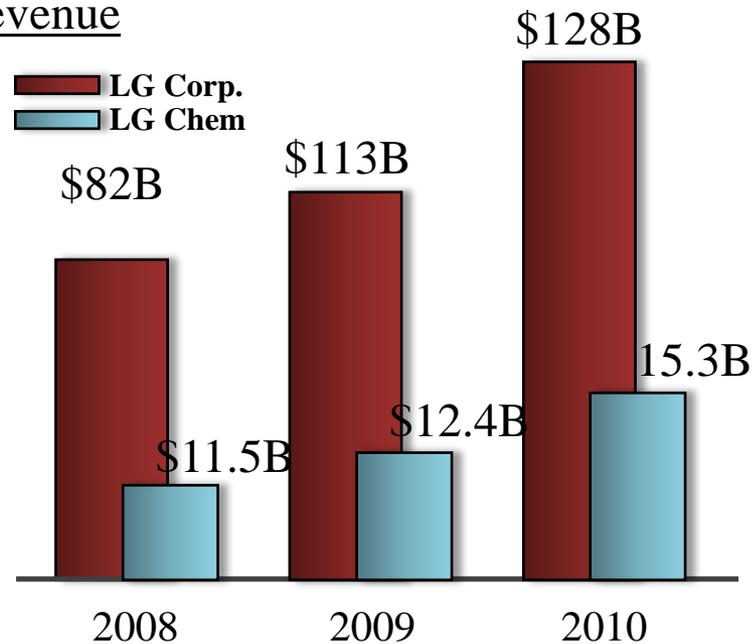
- Established in 1947.
- LG Chem: Mother company of LG Corp.
- 52 Subsidiaries in LG Corp.

Key achievements

Number of employees in LG Corp.



Revenue



[Assumption: Fixed Exch. Rate: KRW1,100/USD]

Company: LG Chem & LG Chem Michigan Inc.

LG Chem

- The largest vertically integrated chemical company in Korea.
- Engaged in research and development, manufacturing and marketing of petrochemicals, information and electronic materials.
- Produces ABS, PVC, synthetic rubbers, specialty polymers and other petrochemical products; lithium-ion rechargeable batteries for portable electric application, advanced rechargeable batteries for automotive application, LCD polarizer, PDP filters, and other information and electronic materials.

LG Chem Michigan Inc. (“LGCMI”)

- A wholly-owned North American subsidiary of LG Chem.
- Established in October, 2000. (→ Formerly known as Compact Power, Inc.)
- Manufactures lithium ion battery cells for automotive application at the \$303 million production facility in Holland, Michigan.

Company: LG Chem's Vision & Core Values



Solution*Partner*

Vision **To be a global leader -
Growing with customers by providing
innovative materials and solutions**

**Core
Values**

- **Customer Value Creation**
- **Execution**
- **Mutual Respect**

Program Objective

Objective: Li-Ion Battery Cell Manufacturing Facility

- To design, construct, start-up and test a production facility for Li-Ion Polymer Batteries in Holland, Michigan.
 - ❑ After starting assembly operations in 2012, an expansion of production capability will continue through 2013 with the addition of a high volume electrode manufacturing line and more assembly lines.
 - ❑ When it reaches full-scale operation in 2013, more than 390 direct employees (Operators, Engineers, Management & Administration staff) will be working at the facility.

Milestones

<u>Date</u>	<u>Milestones</u>
02/2010	DOE Grant Award
03/2010	Completion of General Contractor Selection
03/2010	Completion of DCAA Audit
06/2010	Completion of EVMS Set-Up
06/2010	Groundbreaking followed by Official Groundbreaking Ceremony
12/2010	Completion of Steel Erection
02/2011	Completion of Enclosure

Approach: Construction/Facility Set-Up

To achieve the program objective, LGCMI's project will be performed in 3 phases.

➤ **Phase 1: Program Management and Planning** (09/2009 – 06/2010)

- ❖ Establish and maintain plans to ensure program performance to requirements, and ensure proper reporting and accountability to meet Award requirements.

➤ **Phase 2: Construction of Cell Manufacturing Facility** (09/2009 – 11/2011)

- ❖ Construct buildings to create a domestic U.S. based advanced lithium-ion battery cell manufacturing capability.

➤ **Phase 3: Equipment Installations and Validation of Production Processes**
(07/2011 – 03/2012)

- ❖ Assure integration with other interfacing processes and systems to minimize production disruptions.

Approach: Utilization of Technological Advantage

LG Chem's Li-Ion battery technology, utilizing laminated packaging with mixed cathode chemistry and Safety Reinforced Separator (SRS™), offers a number of advantages including the following:

➤ Unique design (Stacking of Plates & Folding)

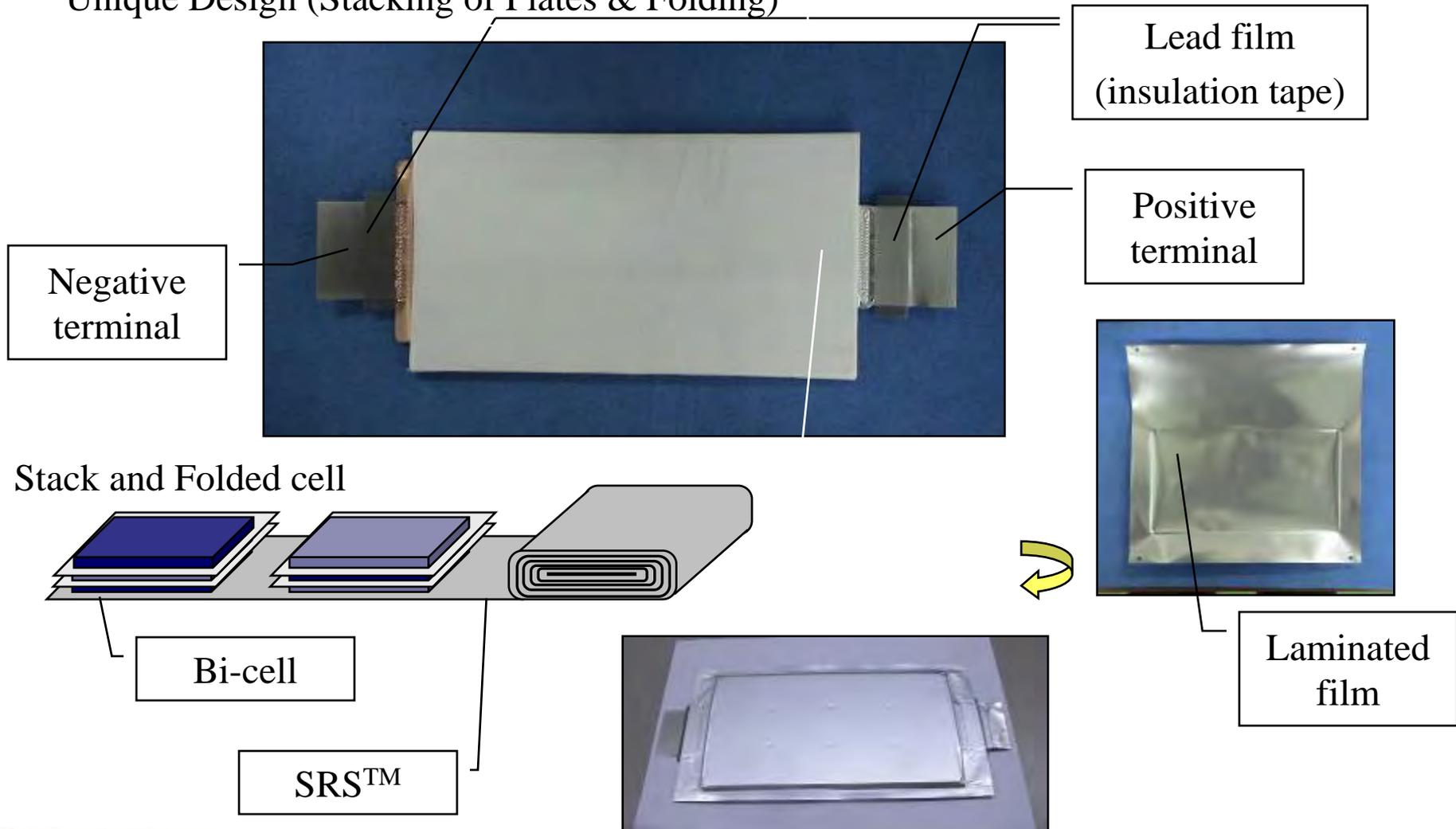
- High rate capability (easy electric current collection)
- More suitable for scaling-up (handling of long electrodes not required)
- Maintains dimensional stability during cycling
- Proven technology in mass production through manufacturing of cells for consumer applications

➤ Robust laminated packaging design

- Simple, more reliable and less expensive manufacturing
- Simpler to change cell footprint

Approach: Technical Advantage

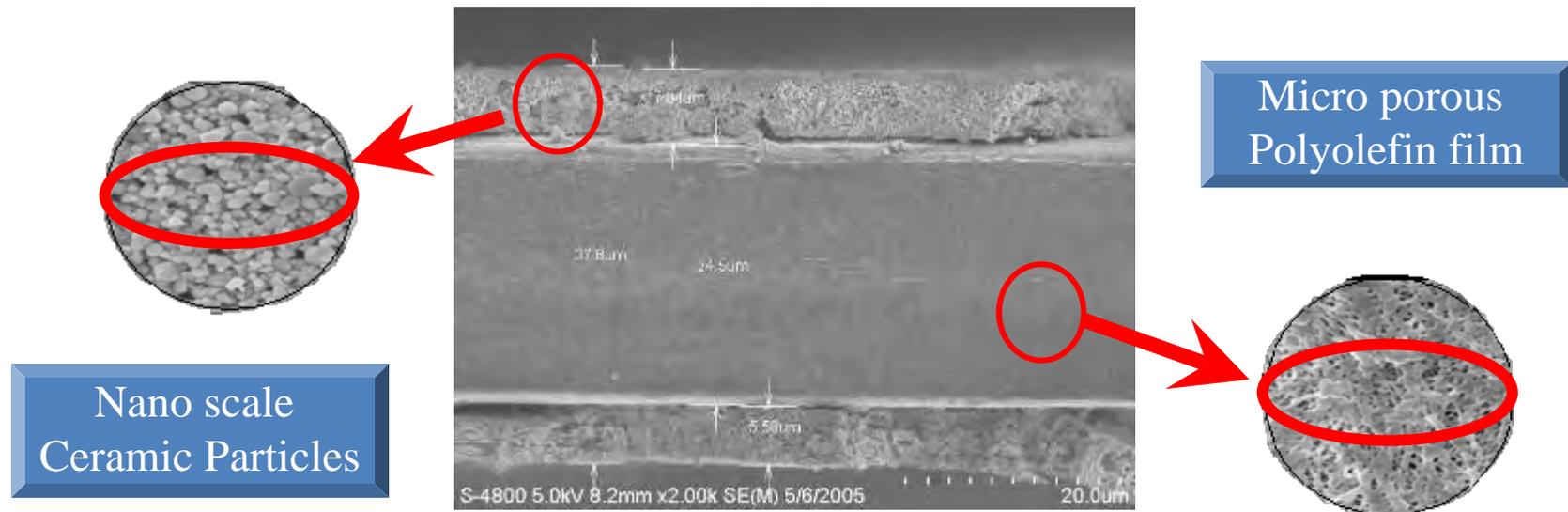
- Unique Design (Stacking of Plates & Folding)



Approach: Technical Advantage

SRS™ provides superior abuse-tolerance

1. By preventing internal short circuit
2. By improved thermal and mechanical strength



• Has ~6x the puncture strength of conventional separator

Approach: Technical Advantage

Components	Materials
Cathode	Mn-Spinel based
Anode	Graphite or Amorphous-carbon
Separator	SRS TM
Electrolyte	LiPF ₆ in Organic solvents (Gel type)
Packaging	Laminated

Accomplishments & Progress

- Completion of Conceptual Design (03/2010)
- Project Announcement in the City of Holland (03/2010)
- Completion of Design Builder Bidding/Selection Process (03/2010)
- Completion of Land Acquisition (05/2010)
- Groundbreaking (06/2010)
- Construction & Environmental Permits/Approval (06/2010)
- Completion of Detailed Due Diligence (9/2010)
- Completion of Design Development (10/2010)
- Completion of Steel Erection (12/2010)
- Completion of Enclosure (02/2011)

Accomplishments & Progress

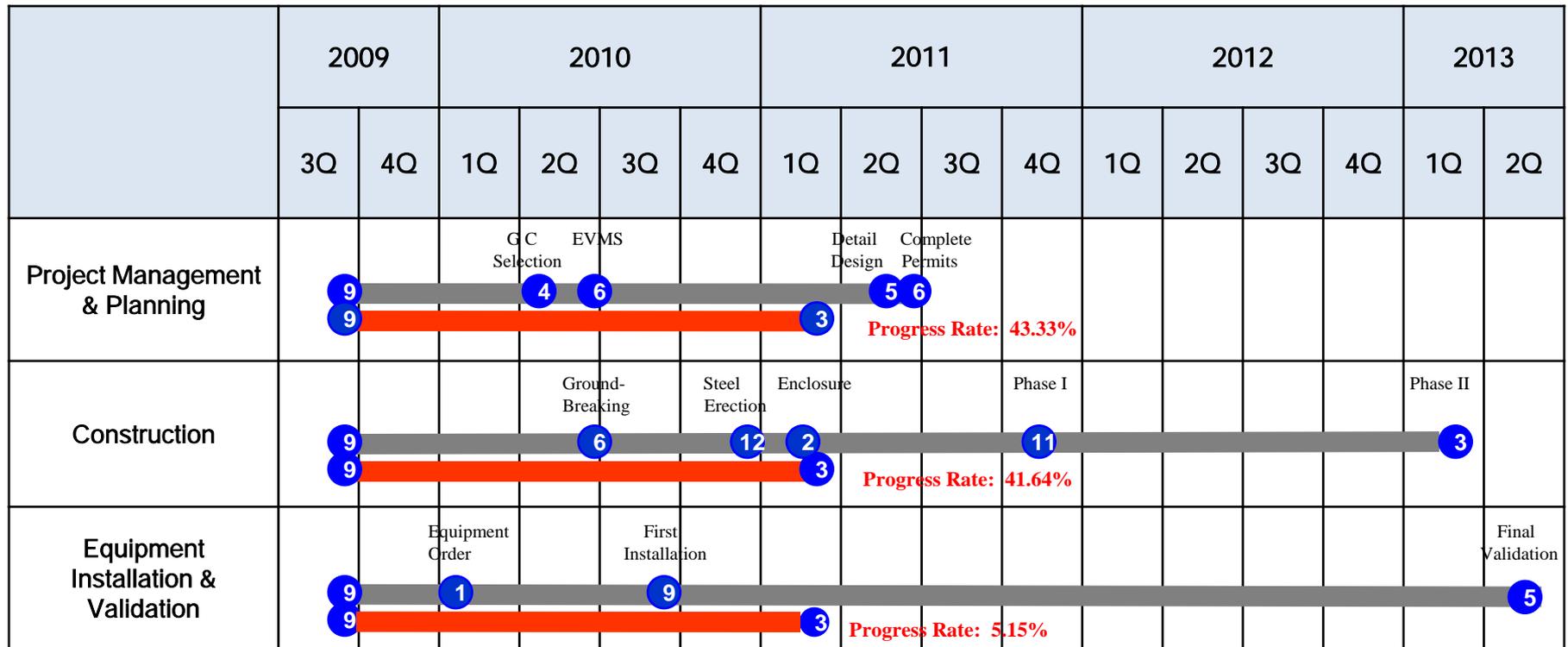
- The DOE Grant Nomination (10/2009)
- Environmental Assessment Report for the NEPA Compliance (12/2009)
- Completion of the DOE Grant Negotiation (02/2010)
- The DOE Grant Award Announcement (02/2010)
- Defense Contract Audit Agency (DCAA) Audit (03/2010)
- Project Kick-off Meeting (03/2010)
- DOE Merit Review Presentation (06/2010)
- Completion of Definitization (07/2010)
- Completion of EVMS Set-Up (06/2010)
- Submission of the Annual Energy Storage Report (11/2010)

Accomplishments & Progress

- Project Announcement in the City of Holland (03/2010)
- Beginning of the Office Staff Hiring (04/2010)
- Relocation of the Management Office to Holland, MI (06/2010)
- On-Site Project Office Set-Up (06/2010)
- Groundbreaking (06/2010) and the Groundbreaking Ceremony (07/2010)
- Beginning of the Hiring Process of Engineers (06/2010)
- Official Corporate Name Change from Compact Power, Inc. to LG Chem Michigan Inc. (09/2010)
- Completion of the Selection Process for Separator Coating Equipment, Assembly & Formation Equipment (10/2010)
- LGCMI's First Job Fair (04/2011)

Accomplishments & Progress

LGCMi's Project Management & Planning, Construction, Equipment Installation & Validation are **on schedule** as of February 28, 2011.



Note: Project progress rates for (i) Project Management & Planning, (ii) Construction, and (iii) Equipment Installation & Validation are calculated based on the EVMS report standard.



Collaborations/Partnerships

Level of collaboration and support from the public and private sectors have been enormously great.

➤ **DOE/NETL**

- Clear guidelines for the DOE billing and reporting requirements
- Quick responses to specific inquiries

➤ **State of Michigan**

- Financial incentives (=tax credit) to LG Chem Michigan Inc.
- Coordination with state agencies (e.g., environmental permits)

➤ **City of Holland**

- Support and assistance in various areas (e.g., road expansion, site preparation)
- Renaissance zone designation in coordination with the state of Michigan

➤ **Private Sector Partnership**

- Timely co-operation and excellent support in the various stages of the project

Future work

To successfully complete the project, LGCMI's future work shall include:

- Completion of Main Utility Set-Up.
- Completion of Building Construction (i.e., building shell, interior & fit-up).
- Installation of Manufacturing Equipment.
- Validation of Separator, Assembly and Electrode Equipment.
- Test Running of the Entire Manufacturing Process.
- Production of battery Cells for Validation.
- Completion of Plant Operator Hiring.
- Extensive Training of the Plant Staff and Operators (i.e., safety, efficient manufacturing, production operations, maintenance, information security).

Summary

- LG Chem/LGCMi has not encountered any significant issues that can become hindrances to its project progress. The project has been on track since its launch.
- LGCMi has been receiving tremendous support from federal, state and municipal authorities.
- LG Chem has a successful track record of developing and manufacturing Li-Ion polymer batteries for electric and hybrid vehicles. LG Chem is confident that it can successfully accomplish the project by utilizing its technological advantage.
- LG Chem's proven track record is evidenced by 9 major customers in the world (as of March 2011).
- The successful completion of this project will create more than 390 direct jobs. In addition, it will reduce U.S. foreign oil dependence.